WE CLAIM:

1. A solid state nuclear magnetic resonance (NMR) method for investigating a sample material that contains protons H and also spin-1/2 hetero nuclei X, the method comprising the steps of:

   a) increasing an equilibrium polarization of X;
   b) suppressing proton magnetization;
   c) transferring polarization from X to H using a radio frequency (RF) pulse sequence which effects transfer between the nuclei X and spatially proximate protons H utilizing a dipole coupling constant D_{XH}, wherein polarization transfer depends only weakly on couplings of nuclei X to spatially distant protons and only weakly on couplings among the protons themselves;
   d) recording proton signals under a line narrowing condition, wherein the sample material is rotated at a magic angle (MAS = magic angle spinning);
   e) repeating steps a) through d) several times while varying an experimental parameter which is clearly physically associated with a polarization transfer process; and
   f) determining a dipole coupling constant D_{XH} by analyzing variations in intensity of proton signals recorded in step d).

2. A method of claim 1, wherein a ratio between a number of H nuclei to a number of X nuclei is larger than or equal to 10:1.

3. The method of claim 2, wherein said ratio is larger than or equal to 100:1.

4. The method of claim 1, wherein the X nuclei in the sample have natural abundance.

5. The method of claim 1, wherein the X nuclei have a gyromagnetic ratio of $\gamma(X) \leq \gamma(^{13}C)$.

6. The method of claim 1, wherein the X nuclei comprise ^{15}N.

7. The method of claim 1, wherein the X nuclei comprise ^{13}C.

8. The method of claim 1, wherein the X nuclei comprise ^{29}Si.

9. The method of claim 1, wherein a polarization transfer from H to X is effected in step a).

10. The method of claim 1, wherein a cross-polarization is applied in step a).

11. The method of claim 1, wherein a field gradient pulse is applied in step b).

12. The method of claim 1, wherein two radio frequency pulses are applied in step b) having a rotary resonance recoupling condition.

13. The method of claim 1, wherein a chemical shift of the X nuclei is encoded between steps b) and c) under proton decoupling in a time interval t_1.

14. The method of claim 1, wherein a TEDOR/REPT sequence is applied in step c), with a time interval t_1' being an experimental parameter which is clearly physically associated with the transfer process, said

time interval t_1' being used between a 90° pulse on X and a 90° pulse on H for encoding the dipole coupling constant D_{XH}.

15. The method of claim 13, wherein a TEDOR/REPT sequence is applied in step c), with a time interval t_1' being an experimental parameter which is clearly physically associated with the transfer process, said time interval H being used between a 90° pulse on X and a 90° pulse on H for encoding the dipole coupling constant D_{XH}.

16. The method of claim 15, wherein steps a) through d) are carried out several times in succession, wherein t_1 and t_1' are simultaneously incremented.

17. The method of claim 16, wherein t_1 and t_1' are incremented with different time increments.

18. The method of claim 1, wherein a TEODOR/REPT sequence is applied in step c), wherein a time interval t_1' between a 90° pulse on X and a 90° pulse on H is fixed and a number of rotor-synchronized 180° pulses is varied as an experimental parameter which is clearly physically associated with a polarization transfer process, wherein intensities in resulting spectra for different numbers of rotor-synchronized 180° pulses are used to determine dipole coupling constants D_{XH}.

19. The method of claim 1, wherein a TEDOR/REPT sequence is applied in step c), and a time interval t_1' between a 90° pulse on X and a 90° pulse on H is fixed and a time difference between rotor-synchronized 180° pulses on X relative to rotor-synchronized 180° pulses on H is varied as an experimental parameter which is clearly physically associated with a polarization transfer process, wherein dipole

coupling constants D_{XH} are determined from spectra extracted for different time differences.

20. The method of claim 19, wherein a chemical shift of the X nuclei is encoded between steps b) and c) under proton decoupling in a time interval t_1 and steps a) through d) are carried out several times in succession, wherein both t_1 and a time difference between the rotor-synchronized 180° pulses on X and rotor-synchronized 180° pulses on H are simultaneously incremented.

21. The method of claim 20, wherein t_1 and said time difference are incremented with different time increments.

22. The method of claim 1, wherein transfer in step c) is effected by a Lee-Goldburg cross-polarization whose time duration is varied as an experimental parameter which is clearly physically associated with a polarization transfer process.

23. The method of claim 1, wherein rapid rotation at the magic angle with a rotation frequency which is larger than or equal to 25 kHz (fast MAS) is only effected in step d).

24. The method of claim 1, wherein rotation at the magic angle is supported by radio frequency pulses in step d).

25. The method of claim 1, wherein rotation at the magic angle is supported by pulsed spin locking in step d).

26. The method of claim 1, wherein the method determines X-H binding separations.

27. The method of claim 26, wherein said binding separations are of hydrogen bridges.

28. The method of claim 1, wherein the method is applied to determine a structure of a peptide chain.